tients is suitability for surgery. I am unclear on a few points in the article, however, and have some questions for the authors.

This landmark work began just after introduction of the Fontan principle. Is this why initial modifications were done in a majority of patients? Or is there another reason? Do you continue to do these modifications today? If so, for what indications and why? The issue of superiority of 1 modification over others in long-term results is far from resolved. For budding cardiac surgeons like me, which type of modification do you recommend for hemodynamically adequate adult patients? In other words, what should govern my choice of modification in different sets of patients?

The fenestrated Fontan modification has widened the horizon of univentricular repair. You have elaborately described your point. Do you feel in spite of anticoagulation the incidence of thromboembolic and other side effects or complications outweighs the benefit of fenestration in decreasing the morbidity of procedure, which has been vigorously tested? Does the age of the patients also affect the decision to fenestrate? If yes, in what way?[2,3]

What is your policy regarding 1-stage or 2-stage procedure? For example, do you perform superior cavopulmonary first and then complete the Fontan as a separate procedure, especially for patients without palliation or with systemic to pulmonary artery shunts or pulmonary artery banding? Is the principle of gradual volume unloading of the ventricle different in adults than children?

Once again, I thank the authors for this outstanding article.

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Reply to the Editor:

In the setting of single ventricle physiology, the common and accepted practice is to proceed with the Fontan procedure at 2 to 4 years of age in the majority of circumstances. In developing countries, the opportunity for staged palliation with eventual Fontan procedure in young children is less common. Some children may have undergone a palliative operation with a systemic-to-pulmonary artery shunt or cavopulmonary shunt during early childhood but were lost to follow-up or never had the opportunity for the completion Fontan procedure. Consequently, there are potentially a greater number of older patients who may be candidates for the Fontan procedure in developing countries.

In our experience with more than 1000 patients, surgical modifications to the Fontan procedure have evolved over the last 3 decades in an effort to avoid complications occurring late after operation. Currently, the technique of the Fontan procedure that is applied in our patients includes the total cavopulmonary connection with an extracardiac conduit or intra-atrial conduit. We believe this technique will minimize the incidence of late atrial arrhythmias.

To reduce the risk of thromboembolism, we eliminate blind stumps (eg, segment above the pulmonary valve) and blind intracardiac chambers (eg, vestigial right ventricle in tricuspid atresia via the ventricular septal defect) that are exposed to the systemic circulation. This is accomplished by patch or suture closure of the pulmonary valve annulus or closure of the ventricular septal defect.

When significant risk factors for early mortality are present prior to the Fontan procedure, such as severe atrioventricular valve regurgitation, severe pulmonary artery abnormalities, or severe subaortic stenosis, we would proceed with a staged surgical approach that corrects these abnormalities prior to the completion Fontan procedure. This would include repair or replacement of the atrioventricular valve, relief of pulmonary artery stenosis or distortion, and relief of subaortic stenosis (resection or Damus-Stansel-Kaye anastomosis). A concomitant bidirectional cavopulmonary anastomosis is also commonly performed at this time. The completion of the Fontan procedure would then be performed at a subsequent operation. Minor intracardiac or pulmonary artery abnormalities are corrected at the time of the Fontan procedure. In the absence of risk factors, we do not believe it is necessary to perform a bidirectional cavopulmonary shunt prior to the Fontan procedure.

We have used the fenestration selectively at the time of the Fontan procedure. Although we attempt to correct major abnormalities during the course of a staged surgical approach in an effort to reduce operative risk, some reversible risk factors for early or late mortality may still be present. These may include elevated preoperative pulmonary artery pressure, reversible ventricular dysfunction, increased ventricular mass, or uncorrected pulmonary artery abnormalities. Fenestration has also been used in patients with predominant right ventricular morphology.

The role of warfarin anticoagulation after the Fontan procedure has been controversial. In general, we tend to anticoagulate most adult patients, particularly those with a fenestration or residual intracardiac shunt, history of arrhythmias, intracardiac thrombus, slow circulation, and venous varices. In children and young adult patients, we may substitute aspirin as an alternative to warfarin anticoagulation.

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Mitral valve surgery with extensive calcification of the annulus

To the Editor:

Feindel and coauthors[1] report results in a challenging set of patients, those with mitral annular calcification (MAC) causing mitral regurgitation. Several alternative techniques to avoid excising the calcified bar all have disadvantages. Displacing the prosthetic sewing line into the left atrium (with or without a prosthetic cuff) subjects the left atrium to high ventricular pressure. Sewing to the mitral leaflets central to the calcified bar requires sewing to fragile tissue and downsizing the valve. Sewing to the calcified bar usually leads to dehiscence, and trying to pass the sutures around the bar jeopardizes the circumflex coronary artery.

An ultrasonic decalcification tool easily pulverizes and extracts the MAC.[2,3] This device spares soft tissue, and hence the circumflex coronary artery is preserved. Because the left ventricle, left atrium, and mitral leaflet(s) are largely disconnected, reconstruction may require an annular patch as Feindel and coworkers[1] describe for valve repair. For valve replacement, sutures passed from left atrium, to left ventricle, around the residual mitral leaflet, and through the prosthetic annulus suffice to reconstitute the annulus.[2] Because the vital structures of the atrioventricular (AV) groove fall posteriorly, the visualization of the top of the left ventricle where it abuts the annulus allows the placement of sutures deep into the muscle without injuring the AV groove vessels.

I have used this technique in 38 patients, 19 of whose results were previously reported.[3] The mean age was 73 years (range 56-84 years), and the mean circumferential calcification requiring debridement was 157° (range 45°-330°). Six patients had mitral repairs; 32 had replacements (17 St Jude Medical [St Jude Medical, Inc, St Paul, Minn], 15 porcine). At the time of operation, 2 patients were noted to have a posterior AV groove hematoma: 1 resolved without treatment, and 1 patient died 1 month postoperatively of multiorgan failure but the hematoma could not be shown to be a contributing factor. Four other patients died. None of the deaths were related to the annular decalcification. No patient developed a paravalvular leak. No patient suffered injury to the circumflex coronary artery or the coronary sinus.

This technique may be underappreciated and underused. I have been frustrated by attempts to excise the calcified bar as described by Carpentier and colleagues.[4] It has seemed to be sufficiently imbedded in the annulus and adjacent structures that I feared damaging the circumflex coronary artery or great coronary vein/coronary sinus. The very gentle debridement rendered by the ultrasonic aspirator makes it a valuable tool that I continue to use and recommend. Its ability to pulverize selectively the hard calcified tissue without injuring soft tissue permits safely attaining complete pliability in the annular region. As Feindel and colleagues[1] made clear, a major concern of any procedure to remove the MAC is the potential of AV separation, and considerable care must be taken in the reconstitution of this area.

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Reply to the Editor:

I would like to thank Dr Vander Salm for bringing this unique method for managing extensive mitral annular calcification to our attention. Although we have no experience with the use of ultrasound decalcification, it appears to be a very useful method in these cases. Surgeons who have such ultrasound devices available to them should consider using them to remove the calcium bar. Any method that reduces the risk of operating on these patients is welcomed. There are good reasons why some have referred to the calcium bar in the mitral annulus as the "Bar of Death."

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Early failure of bovine jugular vein conduits

To the Editor:

We read with great interest the article by Boudjemline and colleagues[1] recently published in *The Journal of Thoracic and Cardiovascular Surgery*. They describe the early results of the bovine jugular vein conduits placed in the right ventricular outflow tract. The event-free survival curve was less than 70% at only 3 months after surgery. There was 1 late death related to the conduit, 1 episode of thrombus formation that required heparin therapy, and another 3 patients required conduit replacement at a mean interval of 4.3 months after the initial operation. An interesting finding was an aneurysmal dilation of the distal portion of the conduit.

Our experience has been similar to that of the authors. Three patients required conduit replacement at 16, 18, and 25 months after the initial operation. All patients had a significant gradient between the right ventricle and the pulmonary artery branches, mainly the left main pulmonary branch; an aneurysmal dilation of the distal conduit occurred in 2 patients and varying degrees of pulmonary insufficiency occurred in all. Conduit diameters were 12 mm in 2 patients and 14 mm in the other patient. All patients were on antiaggregant therapy, which is our standard management protocol for grafts.

Findings at surgery were disappearance of the conduit valve, presence of a huge aneurysmal dilation of the conduit in 2 cases, and extensive fibrosis at the conduit-pulmonary artery anastomotic line in all. This particular finding is of extreme importance, since our patients, as well as 2 patients in Boudjemline's article, have persistent residual pulmonary artery stenosis, despite extensive reconstruction during conduit replacement.

The bovine jugular vein conduit promised to be the conduit of choice for use in neonates and infants due to its excellent handling properties, but these early and midterm complications should raise a note of caution on its use.

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